APPARATUS AND METHOD OF INSTALLATION OF A MONO-COLUMN FLOATING PLATFORM

BACKGROUND OF THE DISCLOSURE

The present invention relates to a method for the installation of a floating platform, and more particularly, to a method for the installation of a mono-column TLP (tension leg platform) in deepwater which is not dependent on deepwater heavy lift vessels.

The usual method of installing a mono-column TLP includes (1) installing anchor piles in the seabed, (2) connecting tendons to the anchor piles, (3) installing the platform hull and connecting it to the tendons, (4) lifting and setting the deck on the hull, and (5) completing hook-up of interfaces. This installation method works well in areas such as the Gulf of Mexico, where deepwater heavy lift crane vessels are routinely available and the installation site is not subject to long-period ocean swells.

In some areas of the world, however, deepwater heavy lift vessels are only occasionally present. But when available, in areas such as West Africa, they are not easily utilized because persistent long-period ocean swells cause substantial relative motion between the platform hull being installed and the deepwater heavy lift crane vessel. In such an installation, the crane vessel's hook provides the mono-column hull with a stabilizing upward force as the mono-column hull is lowered into the water through its brief condition of hydrostatic instability after pontoon submergence. The relative motion between these two different vessels, i.e.,between the hull and the deepwater heavy lift vessel, under the action of long period ocean swells, causes unacceptably large variations in hook load.

It is therefore an object of the present invention to provide apparatus and a method for installing a floating platform in areas where deepwater heavy lift vessels are not routinely available.

It is another object of the present invention to provide apparatus and a method for installing a floating platform in areas prone to long-period ocean swells.

SUMMARY OF THE INVENTION

In accordance with the present invention, a mono-column floating platform is provided with temporary buoyancy modules detachably mounted on the hull of the floating platform. Each temporary buoyancy module is provided with removable winches for developing initial pre-tension of the tendons.

BRIEF DESCRIPTION OF THE DRAWINGS

So that the manner in which the above recited features, advantages and objects of the present invention are attained can be understood in detail, a more particular description of the invention briefly summarized above, may be had by reference to the embodiments thereof which are illustrated in the appended drawings.

It is noted, however, that the appended drawings illustrate only typical embodiments of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

Fig. 1 illustrates a floating platform of the invention being dry-towed to an offshore assembly area;

Fig. 1A is an enlarged partial perspective view depicting temporary buoyancy module and winch arrangement of the invention;

Fig. 2 illustrates a floating platform of the invention being off-loaded at an offshore assembly area;

Fig. 3 illustrates a floating platform of the invention ballasted down to installation draft;

Fig. 4 illustrates a floating platform of the invention being towed to an installation site;

Fig. 5 illustrates a floating platform of the invention being positioned for connection to pre-installed tendons for anchoring the floating platform to the seabed;

Fig. 6 illustrates a floating platform of the invention being ballasted down and winches connected to the tendons for developing initial pretension of the tendons;

Fig. 7 illustrates a floating platform of the invention with the tendons locked and the hull of the floating platform deballasted;

Fig. 8 illustrates a floating platform of the invention depicting the winch decks removed from the temporary buoyancy modules;

Fig. 9 illustrates a floating platform of the invention depicting the temporary buoyancy modules removed and complete installation of the floating platform; and

Figs. 10 - 14 illustrate an alternate installation sequence in accordance with the present invention wherein the temporary buoyancy modules of the invention are hingedly secured to a floating platform.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring first to Fig. 1, a floating platform of the present invention is generally identified by the reference numeral 10. The platform 10 includes a hull 12 which provides positive buoyancy and vertical support for the platform 10. The hull 12 comprises a central column 13 and pontoons 18 extending radially outwardly from the lower end of the central column 13. One or more decks 14 are supported on the central column 13 above the water surface 16. Drilling and/or production equipment necessary for the recovery and processing of oil, gas and water recovered from the oil and gas field are secured on the deck 14.

The lower portion of the central column 13 forms the base of the platform 10. The base of the platform 10 is at the intersection of the central column 13 and the pontoons 18 extending radially outwardly therefrom. The platform 10 is anchored to the seabed by tendons 20 secured at one end thereof to the pontoons 18, as shown in Fig. 5, and at the opposite ends thereof to foundation piles (not shown in the drawings) embedded in the seabed. The hull 12 provides sufficient buoyancy to support the payload of the platform 10; which payload includes the deck 14, drilling and/or completion equipment, production facilities, production and drilling risers; and sufficient excess buoyancy to develop the tendon pre-tension required by the platform 10.

In a typical installation of a mono-column floating platform , the hull 12 is towed to the installation site and maneuvered over tendons 20 which have been pre-installed and connected at the lower ends thereof to foundation piles embedded in the seabed. The hull 12 is stable floating on the pontoons 18 because of the large water plane area provided by the pontoons 18. The hull 12, however, becomes hydrostatically unstable when the pontoons 18 are fully submerged below the water line 16. For such an installation, a heavy lift vessel is typically utilized to provide the hull 12 with a stabilizing upward force as the hull 12 is lowered into the water for connection to the tendons 20. The deck 14 is then lifted by the heavy lift vessel and set on the hull 12. However, in some areas of the world, heavy lift vessels are not readily available. Heavy lift vessels are also not particularly suitable for use at installation sites subject to long-period ocean swells.

Referring again to Fig. 1, it will be observed that the platform 10 of the invention is substantially assembled, including the deck 14 mounted on the central column 13, and dry-towed to an offshore site where the water depth is sufficient to lower the platform 10 in the water to an installation draft. Temporary buoyancy modules 30 are mounted on the pontoons 18 at the distal ends thereof.

Referring now to Fig. 1A, a temporary buoyancy module of the invention generally identified by the reference numeral 30 is shown in greater detail. The buoyancy module 30 includes a floodable tank 32 secured on top of the pontoons 18. The tank 32 is provided with the necessary plumbing, including a fill port and vent, for connection with a ballast system used during installation. In a preferred embodiment shown in Fig. 1A, brackets 34 provided on the pontoons 18 are adapted for mating engagement with padeyes 36 provided on the tank 32. A connector pin 38 inserted through the aligned brackets 34 and padeyes 36 fixedly secures the temporary buoyancy module 30 on top of the pontoons 18 at the distal ends thereof.

A removable temporary winch deck 40 is mounted on top of the tank 32 of the temporary buoyancy modules 30. The winch deck 40 provides a dry deck area to support one or more winches 42. The winches 42 are powered by hydraulic power units 44 or the like mounted on the winch deck 40. The winches 42 are supported on the temporary buoyancy modules 30 directly above the pre-installed tendons 20. Winch lines 46 connect the winches 42 to the tendons 20 for developing initial pre-tension in the tendons 20.

Referring now to Figs. 1-9 collectively, the installation sequence for the platform 10 of the invention 10 is shown. One benefit of the present invention is that the platform 10 may be substantially assembled on shore. The assembled platform 10 is dry-towed to an offshore site where the water depth is sufficient for off loading the platform 10 and ballasting down to installation draft as shown in Fig. 3. The temporary buoyancy modules 30 maintain the stability of the platform 10 as it is lowered into the water by providing water plane areas at a relatively large distance from the axial center of the platform 10 for efficiently developing a righting moment as the platform 10 is lowered from its stable position floating on the pontoons 18 to an otherwise unstable position immediately after the pontoons 18 submerge below the water surface 16. The upper ends of the temporary buoyancy modules 30 extend above the water surface 16 providing a dry deck area for the winches 42.

Thereafter the platform 10 is towed to the installation site and positioned above the pre-installed tendons 20. The winch lines 46 are connected to the tendons 20 for holding the platform 10 in position above the tendons 20 and then the winches 42 are activated. The hull 12 is lowered toward the tendons 20 by ballasting and then the hull 12 is pulled down by the winches 42 to gain initial pretension. The tendons 20 are locked in the tendon porches 50 located on the pontoons 18 and the hull 12 is deballasted to develop the tendon pre-tension required to provide stability to the platform 10. The winch decks 40 and temporary buoyancy modules 30 are removed and installation of the platform 10 is completed. The temporary buoyancy modules 30 and winch deck 40 and winches 42 may be shipped and re-used in installations at other locations.

Referring now to Figs. 10 - 14, an alternate installation sequence is depicted. In some offshore environments it may be desirable to transport the floating platform 10 to the installation site with the temporary buoyancy modules laying down on top of the pontoons 18. For such environments, an alternate embodiment of the temporary buoyancy modules generally identified by the reference numeral 60 is provided. The temporary buoyancy modules 60 include a lower angular transition portion 62 terminating at a lower edge 66. The temporaty buoyancy modules 60 are releasably connected to the distal ends of the pontoons 18. Any number of releasable connection means may be utilized to securely mount the buoyancy modules 60 to the pontoons 18. In a preferred embodiment shown in Figs. 10 - 14, hinge brackets 64 pivotally secure the buoyancy modules 60 to the distal ends of the pontoons 18.

The temporary buoyancy modules 60 further include a floodable tank 68 (substantially identical to the tank 32 previously described herein) welded, integrally formed therewith or otherwise mounted on top of the transition portion 62. The tank 68 is provided with the necessary plumbing, including a fill port and vent, for connection with a ballast system used during installation.

Referring still to Figs. 10 - 14 and in accordance with the alternate installation sequence, the assembled platform 10 is dry-towed to the installation site. For transport to the installation site, the temporary buoyancy modules 60 are rotated to a horizontal position and lay down on top of the pontoons 18 as shown in Fig. 10. At the installation site, the platform 10 is offloaded and the temporary buoyancy modules 60 are rotated about the hinge brackets 64 to an upright position shown in Fig. 12. After rotation, a connector pin 70 is inserted through aligned padeyes 72 and 74 on the modules 60 and the pontoons 18, respectively, to secure the temporary buoyancy modules 60 in the upright position shown in Fig. 12. The winch and deck assemblies are thereafter mounted on top of the temporary buoyancy modules 60 and the platform 10 is lowered in the water and connected to the tendons 20 and the buoyancy modules 60 are removed similarly to the manner previously described herein.

While a preferred embodiment of the invention has been shown and described, other and further embodiments of the invention may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims which follow.